ELECTROMAGNETIC ENERGY INTERFERENCE SEAL FOR LIGHT BEAM TOUCH PANELS

BACKGROUND OF THE INVENTION

The invention relates generally to touch panel display systems, and more particularly, to sealing light beam touch panel display systems against electromagnetic energy interference.

Patents disclosing such touch panel display systems include U.S. Pat. No. 3,764,813 to Clement et al., granted Oct. 9, 1973; U.S. Pat. No. 3,775,560 to Ebeling et al., granted Nov. 27, 1973; and U.S. Pat. No. 4,198,623 to Misek et al., granted Apr. 15, 1980. In systems such as these where light beam sources direct beams of light across the face of a display toward light beam detectors located on the other side of the display, electromagnetic energy may escape from the display unit and allow its detection and it may also interfere with sensitive electronic equipment in the immediate area. Also, external electromagnetic energy may enter the display unit and interfere with its operation. Prior electromagnetic energy shielding arrangements for touch panel display units have been complex, bulky, and have not been sufficiently integrated with the display unit. These prior arrangements have, in some cases, made maintenance of the display unit more difficult and have typically not been of the type which also enhance display operations.

Various internal touch panel circuits as well as various display circuits generate signals which may radiate from the display unit. Where square wave signals are used inside the display unit, harmonics of relatively high frequency may escape. Where the touch panel display unit is to be used in an environment requiring the control of compromising emanations, suppressing the radiation of such signals may be required in order to avoid detection. In the case where the display unit is located near other equipment which radiates electromagnetic energy, such as a radar system, exposure of the display unit circuits to that energy may cause faults, processing errors or have other detrimental effects on display unit operation. As used herein, electromagnetic energy interference refers to signals which are of lower frequency than that of the touch panel light beams.

Prior touch panel light beam systems are also susceptible to extraneous light striking the light beam detectors. Such light lowers the signal to noise ratio of the light beam system and, if intense enough, may disable the system since the detector will be biased by the extraneous light and will not sense an interruption in the light beam. An effect such as this occurs in some prior light beam systems near the edge or border of the display. In that area, the light beam may be reflected by the raised border of the display and strike the detector at an angle acute to the straight line between the light beam source and dectector. If the reflection is strong enough, the detector will be biased by such reflection and will not sense an interruption of the main beam in certain places. A prior technique for defeating this border reflection is installing a protruding opaque object or "reflection fence" at the border to disrupt reflections. However, this technique does not solve the problem of lowered signal to noise ratio due to extraneous light.

Accordingly, it is an object of the invention to provide an electromagnetic energy interference seal which

impedes the propagation of electromagnetic energy interference into and out of a touch panel display unit.

It is also an object of the invention to provide an electromagnetic energy interference sealing arrangement for use in a touch panel display system which reduces the amount of extraneous and ambient light reaching the light beam detectors thereby resulting in an improved signal to noise ratio in the touch panel area.

It is also an object of the invention to provide an electromagnetic energy interference sealing arrangement for use in a touch panel display system having improved efficiency and improved reliability over prior touch panel display system seal arrangements.

SUMMARY OF THE INVENTION

The foregoing objects and other objects are attained wherein there is provided an electrically conductive electromagnetic energy interference seal which borders the display and seals the display unit against electromagnetic energy interference while improving the signal to noise ratio of the light beam system. More particularly, an electromagnetic energy interference seal arrangement is provided which comprises an electrically conductive seal for placement around the periphery of the display touch panel active area, and in which waveguides have been formed to provide for the transmission of and to guide the light beams. These waveguides are electrically conductive and have a particular aspect ratio of length to cross-section so that they function as waveguides above cutoff for transmitting the light beams but operate below cutoff for electromagnetic energy interference, thus filtering out that interference. In addition to preventing the propagation of electromagnetic energy interference into or out of the display unit, these waveguides collimate the light beams used in the touch panel system and improve the signal to noise ratio by shading against extraneous light.

In the case where an electrically conductive display outer enclosure surrounds the sides, top, bottom, and back of the display unit, and an electrically conductive front bezel is used, the electromagnetic energy interference seal arrangement of the invention may be positioned between the front bezel and the display screen to provide electromagnetic energy interference shielding between the two. Where a display faceplate is used, it may also be made electrically conductive such as by means of forming it of an electrically conductive material, using an embedded wire mesh or by applying a conductive coating to enhance electromagnetic energy interference sealing of the display system. The electrically conductive faceplate would be placed in electrical contact with the seal arrangement to form a completely electrically conductive housing.

For environmentally sealing the light beam waveguides against dust, dirt, liquids and other contaminants, a strip of material which is transparent to the light beams is mounted over the external and internal openings of the waveguides.

For mounting the electromagnetic energy interference seal in accordance with the invention to the electrically conductive faceplate, an electrically conductive adhesive compound is used which permits nondestructive disassembly. This technique preserves the electromagnetic energy interference seal when assembled and facilitates disassembly and maintenance of the display system.